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RESEARCH HIGHLIGHTS

1989-1990

U. S. SUGARCANE FIELD LABORATORY

8/27/92

Sugarcane Research Unit
Agricultural Research Service
United States Department of Agriculture
Houma, Louisiana

a845

MISSION AND STAFF

The mission of the Sugarcane Research Unit is to conduct basic and applied research with the objective of increasing sugarcane production efficiency in the lower Mississippi Delta. A major goal of the Unit is to develop improved sugarcane germplasm and cultivars through conventional breeding and molecular approaches that combine high yield of sugarcane per unit area and sugar per ton of cane, as well as have resistance to disease and insect pests, cold tolerance, ratoon longevity, erectness, and suitability to mechanical harvesting. An equally important goal is to develop efficient, integrated sugarcane production systems involving improved weed, disease and insect control methods and cultural practices.

The productivity of the Research Unit has been greatly enhanced by the support of the American Sugar Cane League and the cooperation of the Louisiana Agricultural Experiment Station. The research reported here is a progress report of recent research*. The current USDA-ARS professional staff and the authors of this report are as follows:

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* The data and interpretations in this report may be modified by additional experimentation; therefore, the report should not be published in part or whole without prior approval of the Sugarcane Research Unit, USDA-ARS, Houma, Louisiana and the cooperating agencies and organizations concerned.

BREEDING

Basic Crosses. Most Louisiana commercial varieties can be traced to only a relatively few wild relatives. To broaden the genetic base, a basic breeding program was established at Houma in 1972 with several objectives: improve resistance to diseases - sugarcane mosaic virus, sugarcane smut, and ratoon stunting disease; improve resistance to the sugarcane borer; improve leaf and stalk cold tolerance; and increase cane yield through better ratooning ability and better adaptation to mechanical harvesting. The sequence of the backcross procedure used in the basic breeding program is as follows: 1) cross commercial variety with wild clone; 2) select for desirable type in the hybrid population; 3) cross commercial variety with selected hybrid; and, 4) repeat steps 2 and 3 several times to recover desirable hybrid derivatives.

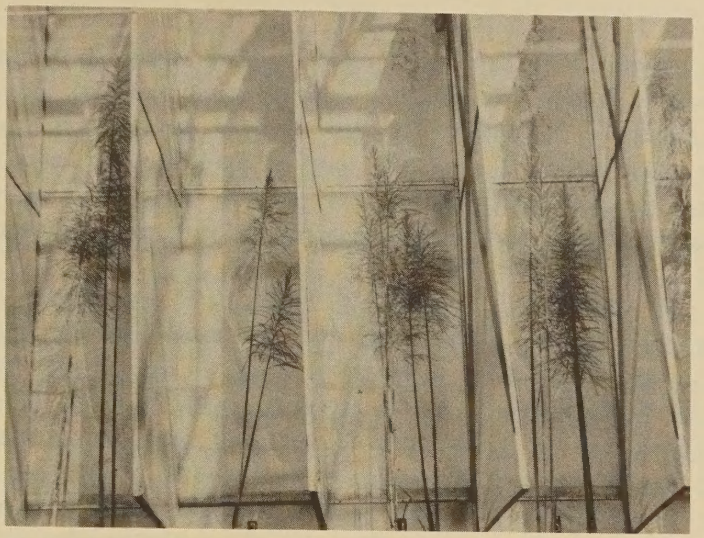
All crossing data (cross number, male and female parents, breeding line, flowering date, and seed yield) from 1972 to present are computerized to facilitate parental selection. Nearly 5 million estimated viable seed have been produced from 3100 crosses in the basic crossing program at Houma; more than 450 thousand seedlings have been set to the field. To-date, 98 candidate varieties derived from crosses involving basic breeding lines have been assigned permanent CP (Canal Point) numbers at Houma. In the future, these candidate varieties will be assigned Ho (Houma) numbers. One variety, LHo 83-153 (the letters indicate that the cross was made at Houma and selected at Louisiana State University), a BC4 derivative of Saccharum spontaneum clone US 56-15-8, was commercially released in 1991. An additional 336 clones from basic crosses have been assigned US (United States) numbers and are used exclusively in the basic breeding program as sources of new germplasm.

Although the transfer of resistance to sugarcane mosaic virus has been the major success of the basic breeding program, research has shown that a number of the US assignments had resistance to brittleness equal to or greater than NCo 310, the most resistant commercial standard. Future crosses involving these clones should provide the basis for commercial varieties with improved adaptability to mechanical harvesting.
(D.M. Burner and B.L. Legendre)

Summary of basic breeding program at Houma, LA.

Breeding	Seedlings set to field	Established in 1st line trials	Established in 2nd line trials	Superior clones receiving permanent assignments US	CP
1972-81	243,645	12,752	1,890	251	67
1982	23,652	2,230	426	31	12
1983	16,552	792	126	17	3
1984	28,640	1,980	225	22	16
1985	29,088	1,578	273	15	0
1986	28,900	1,557	197	*	*
1987	21,166	1,527	106	*	*
1988	22,425	659	*	*	*
1989	21,605	*	*	*	*
1990	18,144	*	*	*	*
Total	453,817	23,075	3,273	336	98

* Data not yet available.



Sugarcane crosses in isolation cubicles of greenhouse.

Early Selection. The early selection phase of the sugarcane breeding program at Houma is divided into four distinct stages: Stage I, Seedling nurseries planted as spaced (16 in) single stools; Stage II, First-line or first-clonal trials (1 row X 6 ft long); Stage III, Second-line or second-clonal trials (1 row X 17 ft long); and, Stage IV, Replicated nurseries (five locations X 2 or 3 replications, 1 row X 17 ft long). Single stools and first-line trials are advanced to the next stage based on freedom of diseases (mosaic and smut), stalk diameter and height, overall vigor, erectness, absence of pith or hole, and refractometer Brix. Single stools are normally selected in the first-stubble crop while the first-line trials are selected in the plant-cane crop. Second-line trials are selected in both the plant-cane and first-stubble crops on the basis of the estimated yield of theoretical recoverable sugar per acre (TRS/A). Data taken in these plots include laboratory Brix, sucrose, purity, and mean stalk weight from a 10-stalk sample. TRS/A is calculated from the stalk population per plot and theoretical recoverable sugar per ton of cane (TRS). Permanent CP (Canal Point), Ho (Houma), or US (United States) numbers are assigned to selected clones from the first-stubble crop of the second-line trials. Replicated nurseries are now planted at five locations [two at the Ardoyne Farm (one on light and one on heavy soils), one at St. Gabriel (LAES), one at Jeanerette (LAES), and one at Bunkie (Newton Farm)]. Selection in replicated nurseries is based primarily on TRS/A and the absence of diseases.

Over 92,000 sugarcane seedlings (71% from commercial crosses made at Canal Point and 29% from basic and special crosses made at Houma) were planted to the field in 1989. Concurrently, 8,437 and 1,075 clones were advanced to the first- and second-line trials, respectively; 96 clones received permanent CP numbers and were planted to the replicated nurseries; and, 22 clones received US numbers and were reintroduced to the crossing program at Houma. These clones had high Brix, superior agronomic traits, and a high degree of resistance to diseases. New feral germplasm in the basic crossing program has increased the level of resistance to sugarcane mosaic virus. Low yield potential (TRS/A) in plant and/or stubble crops and sugarcane smut were the main reasons for discarding new varieties in the replicated trials.

In 1990, 114,511 sugarcane seedlings (20% more than in 1989) were planted to the field. The proportion of commercial to basic seedlings remained essentially the same as in 1989. The December 1989 freeze destroyed over 95% of the seedlings planted in 1989. Only 2,455 (2.8% of total) clones were established in first-line trials from first-stubble seedlings. The only selection criteria used were that the seedlings survived the freeze and that the stool have sufficient number and height of stalks to plant to the first-line trials. An additional 3,323 clones were established in first-line trials from plant-cane seedlings planted in 1989. A total of 1,202 clones were advanced to second-line trials, 90 clones assigned permanent CP numbers, and 20 clones received permanent US numbers. Clones advanced should have a high degree of cold tolerance. Low yield potential (TRS/A) in plant and/or stubble crops, disease incidence, and poor harvestability were the main reasons for discarding new varieties in the replicated trials. **(B.L. Legendre)**

Secondary Selection. In the sugarcane breeding program at Houma, the secondary selection stage is known as the infield testing stage (Stage V). This is the first stage of the breeding program in which plots are mechanically harvested and then weighed with a tractor-mounted hydraulic weighing system. Varieties tested in the infield come from the federal breeding program (CP's and Ho's) and the state breeding program (L's, LCP's and LHo's). Selection criteria emphasized in the infield are sucrose content, stalk number, stalk weight, estimated yield of cane and sugar per unit area, and harvestability.

Candidate varieties are tested in replicated experiments [2 or 3 replications, with each plot 3 rows (18 ft) wide x 16 ft long]. For comparison, three commercial varieties (CP 65-357, CP 70-321, and CP 74-383) are included as controls in each infield test. To be considered for further testing, experimental varieties must equal or exceed the control varieties in yield of sugar per unit area, possess an acceptable level of disease and insect resistance, and have adaptability to mechanical harvesting and good milling qualities (low fiber and good juice extraction).

In 1990, 20 varieties from the 1987 CP and LCP series, 39 varieties from the 1988 CP and LCP series, and 57 varieties from the 1989 CP series were planted in infield tests. These tests will be harvested in 1991, as will the first-stubble of the 1986 CP and LCP series, 1987 CP and LCP series, and 1988 CP series, and second-stubble of 1985 CP and LCP series, 1986 CP and LCP series, and 1987 CP series.

Four varieties from the 1985 series remain active in the breeding program. Of these four, CP 85-845 and LCP 85-384 appear the most promising. Although both of these varieties represent different agronomic type, they have similar yields of sugar per acre. CP 85-845 has a stalk weight similar to CP 70-321 and a population that equals or exceeds the commercial varieties in the infield. LCP 85-384 generally has a significantly lower stalk weight than the commercial varieties but has a very high stalk population. In the 1986 series, CP 86-979 and LCP 86-454 have the highest yields. However, it is still too early in the breeding program to determine how these varieties will react to mechanical harvesting. There are several promising varieties in the CP 1987 series. CP 87-652, CP 87-658, and CP 87-663 have consistently equaled or exceeded the commercial varieties in yield of sugar per acre.

The 1985 and 1986 series are also being tested in the outfield stage. The 1987 series will be planted in outfield tests in 1991. **(E.O. Dufrene)**

Outfield Selection. Outfield selection is the final stage in evaluating candidate sugarcane varieties for release to the Louisiana sugarcane industry. Outfield selection is a cooperative effort between USDA-ARS, and the Louisiana Agricultural Experiment Station, and the American Sugar Cane League. The work is conducted in cooperation with sugarcane growers at 12 representative locations

Weighing and collecting samples in outfield variety plots.

within the sugarcane belt of Louisiana. Candidate varieties are tested in replicated experiments [3 replications, with each plot 3 rows (18 ft) wide x 32 ft. long] in the plant-cane, first-stubble, and second-stubble crops on both light and heavy soil. A minimum of five commercial varieties are included as controls in each outfield test.

In 1989 CP 84-730, CP 83-644 and LHo 83-153 were significantly higher than CP 70-321 in sugar per acre on light soil only. In the first-stubble crop, LHo 83-153 and LCP 82-89 were significantly higher than CP 70-321 in sugar per acre on light soil. On light and heavy soil, LCP 82-89 was significantly higher than CP 70-321 in sugar per acre in the second stubble crop. CP 82-551 was significantly higher in sugar per acre in the second-stubble crop on light soil. LCP 82-89 was released for commercial planting in 1990.

Average yield of sugar per acre in outfield tests in the plant, first-stubble and second-stubble crops on light and heavy soils during 1989.

	Sugar per acre		
Variety	Plant cane[1]	First-stubble[2]	Second-stubble[3]
	- - - - - - - -lb- - - - - - -		
CP 70-321	6884	7131	5777
CP 82-551	6920	6652	6705
LCP 82-89	7544	7844	7981

[1] 13 test; [2] 13 tests; [3] 11 tests.

In 1990, CP 84-730 was significantly higher than CP 70-321 in sugar per acre on light and heavy soil in the plant-cane crop. LCP 85-384 was significantly higher than CP 70-321 in sugar per acre only on heavy soil. In the first-stubble crop, LHo 83-153 was significantly higher than CP 70-321 in sugar per acre only on light soil. In the second-stubble crop, CP 82-551 and LHo 83-153 were significantly higher than CP 70-321 in sugar per acre on heavy soil. CP 82-551 and LHo 83-153 will be considered for commercial release in 1991. Both of these varieties have shown good field resistance to both sugarcane mosaic virus and smut. **(D.D. Garrison)**

Average yield of sugar per acre in outfield tests in the plant, first-stubble and second-stubble crops on light and heavy soils during 1990.

	Sugar per acre		
Variety	Plant cane[1]	First-stubble[2]	Second-stubble[3]
	- - - - - - - -lb- - - - - - -		
CP 70-321	7576	7173	3748
CP 82-551	7055	6913	5674
LCP 82-89	7127	6781	4602
LHo 83-153	7150	7311	5682

[1] 9 tests; [2] 7 tests; [3] 4 tests .

Data on Released Varieties. The Louisiana Agricultural Experiment Station of the Louisiana State University Agricultural Center, the Agricultural Research Service of the United States Department of Agriculture, and the American Sugar Cane League of the U.S.A., Inc., working cooperatively to improve sugarcane varieties in Louisiana, jointly developed and announced the release of a new variety, LCP 82-89, for commercial planting in the fall of 1990. LCP 82-89 is a product of the cross CP 52-68 X CP 72-370 made at Canal Point, Florida in 1977, selected by the Louisiana Agricultural Experiment Station, and tested by the three agencies. Data from 77 mechanically harvested outfield trials on both light and heavy soils indicate that LCP 82-89 is superior to CP 70-321 in yield of sugar and cane per acre in plant and stubble crops. LCP 82-89 is similar to CP 70-321 in sugar per ton and maturity, with a fiber content and normal juice extraction intermediate between CP 70-321 and CP 65-357. The variety has been assigned a mill factor of 1.021. LCP 82-89 is generally well suited to mechanical harvesting.

LCP 82-89 is moderately susceptible to spread of sugarcane mosaic virus in the field. It is considered resistant to smut caused by *Ustilago scitaminea* Syd. and appears moderately susceptible to rust caused by *Puccinia melanocephala* H. and P. Syd. under Louisiana field conditions following a mild winter. Ratoon stunting disease caused significant reduction in both cane and sugar yields in stubble crops of LCP 82-89. It is resistant to injury by the sugarcane borer *Diatraea saccharalis* F. Preliminary data suggest LCP 82-89 may be susceptible to injury by some herbicides. **(B.L. Legendre)**

Variety Census. The annual sugarcane variety census is conducted cooperatively by the Louisiana Cooperative Extension Service and the Sugarcane Research Unit, Agricultural Research Service, United States Department of Agriculture. The variety census was conducted in 1990; however, because of the damage to the crop by the December 1989 freeze, the census did not truly express grower preference but rather was a survey of the varieties that survived the freeze. A summary of the surveys conducted from 1986 through 1989 showed that the acreage planted to CP 70-321 has remained constant at approximately 42%. CP 65-357, long the most popular variety, has shown a gradual increase (+6%) in acreage over the period after reaching a low of 22% in 1987. The acreage planted to CP 72-370 and CP 74-383 has remained constant at approximately 10%. Both CP 70-330 and CP 72-356 continue to decrease in popularity while CP 76-331 and CP 79-318 have shown little grower approval because of their poor harvestability. **(B.L. Legendre and D.P. Landry)**

Breeding for Sugarcane Borer Resistance. Progress continues to be made in breeding for sugarcane borer resistance. Presently, five breeding series are being evaluated at various stages. From the most advanced (1986) series, five selections have been assigned a US (United States) number, a designation used by our plant breeders to identify superior breeding canes. One selection from this series which exhibited both resistance and superior yielding potential was assigned a CP (Canal Point) number. This selection will be further evaluated for possible release to Louisiana growers as a commercial variety. With an additional year of evaluation, it is anticipated that one or more of these selections will be registered as germplasm releases possessing superior borer resistance. **(W.H. White and B.L. Legendre)**

TISSUE CULTURE

Phenotypic Variability of Subclones of CP 74-383. Plants regenerated from *in vitro* culture of CP 74-383 may exhibit substantial numbers of offtypes. This limits *in vitro*-facilitated clean seed production. A field study is being conducted to compare variability of plants produced *in vitro* by callus culture, direct regeneration, and shoot tip culture, with that in plants propagated conventionally from seed pieces. In plant cane, *in vitro* propagated plants were inferior to the check. This was due to large numbers of offtypes in tissue culture plants. However, milling data suggest little association between plant morphology (stalk characters and offtype rating) and cane quality (fiber content and TRS). Thus, normal and offtype stalks of similar number and size may not necessarily differ in quality. Subclones with apparently normal phenotype were found in the population of regenerants. Plants will be examined further in ratoon crops.
(D.M. Burner and M.P. Grisham)

Plants Cultured In Vitro from True Seed. Sugarcane was one of the first crop species to be studied using *in vitro* propagation, but there was no report of plant regeneration from callus of mature seed (caryopses). Seed of three varieties (CP 67-412, CP 72-355, and CP 81-311) was tested for regeneration potential. An average of 5.7 (range 3 to 11) plants per germinated seed was obtained from callus.

Six hundred callus-derived subclones of nine seeds (lines) of CP 72-355 were examined for variability in the plant cane crop. There was substantial random variability among subclones within lines. It was not possible to distinguish variability due to *in vitro* culture from random sampling variation. Thus, there appeared to be little useful variation for agronomic characters in the population of subclones. **(D.M. Burner)**

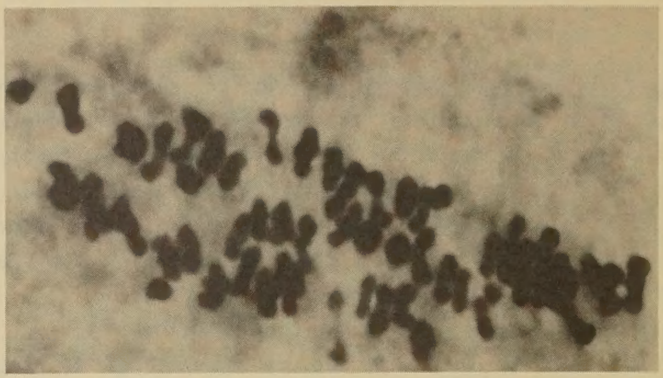
CYTOLOGY

Chromosome number and chromosome pairing have been analyzed for many clones in the basic breeding program. This information is useful in taxonomy, confirming clonal identity, confirming hybrids, and characterizing genetic stability for crossing purposes. In a study of 31 wild sugarcane relatives, the following results were obtained: 1) chromosome numbers were confirmed for 18 clones; 2) chromosome numbers were reported for the first time for six clones; and, 3) chromosome numbers differed from published counts for seven clones. Normal, bivalent chromosome pairing predominated; meiotic irregularity (numeric aberrations, abnormal pairing, and micronuclei) tended to be associated with taxonomic grouping and level of polyploidy. This reflects inherent meiotic instability of sugarcane relatives with high chromosome number. Chromosome pairing in most commercial varieties tends to be more irregular than that of basic species. Common cytological abnormalities of basic breeding lines and commercial varieties include aneuploidy (parents transmit irregular numbers of chromosomes to progeny), mixoploidy (chromosome numbers may differ slightly among cells of a plant), and polysomaty (an extreme form of mixoploidy where some cells of a plant may contain two or more times the normal number of chromosomes). Identification of polysomatic clones could facilitate the nobilization process of sugarcane breeding because these clones, if male fertile, may produce 2n pollen.
(D.M. Burner, B.L. Legendre, and P.Y.P. Tai).

Chromosome counts for selected wild and commercial sugarcane clones.

Clone	Chromosome number	Remarks
US 57-60-2	20	Erianthus rufipilus
US 58-4-2	30	Narenga porphyrocoma
NG 77-22	38	Miscanthus sinensis
Kalimpong	40	E. procerus
SES 189	50	Saccharum spontaneum
SES 371	60	E. bengalense
SES 6	64	S. spontaneum
US 63-6	72	E. brevibarbis
US 56-15-8*	80	S. spontaneum
Local Escape	96	S. spontaneum
CP 65-357	104-115	Cultivar
CP 74-383	104,108-109	Cultivar
L 60-25	112,115	Cultivar
NCo 310	112	Cultivar
NG 77-193	192	Miscanthus hybrid

*LHo83-153 is BC4 of US56-15-8.



Metaphase I of CP 74-383 with 108 chromosomes.

PLANT PATHOLOGY

Sugarcane Mosaic. Varieties of sugarcane were found to differ in the amount of yield loss caused by infection with sugarcane mosaic virus (SCMV). The two most recently released varieties, LCP 82-89 and LHo 83-153, were moderately susceptible and resistant, respectively. Among the currently recommended varieties for Louisiana, only CP 76-331 is resistant to SCMV; others vary from susceptible to moderately resistant.

A study of the establishment and spread of sugarcane mosaic in sugarcane was begun in the fall of 1988. Establishment of initial infections in fields appeared to be random, except in one where mosaic incidence plants were higher adjacent to drainage ditches than in plants in the interior of the field. Plants infected with mosaic in the first year did not appear to be foci for infections in subsequent years. **(M.P. Grisham)**

Sugarcane Smut. Candidate varieties of sugarcane are screened for resistance to smut (Ustilago scitaminea) by dip inoculating seed cane in a 5 X 10^6 teliospores per ml suspension for 10 minutes prior to planting. The mean percent shoots infected is used to group the candidate varieties into resistant, intermediate, and susceptible classes. The 1988 series of varieties had not been previously screened in an inoculated test. The high percentage of varieties in the resistant and intermediate classes among the 1988 series may reflect the elimination of highly susceptible varieties exposed to earlier natural inoculation and better parent selection.
(B.L. Legendre and M.P. Grisham)

Number and percent of CP and L sugarcane varieties assigned to three smut resistance classes following the 1990 trial.

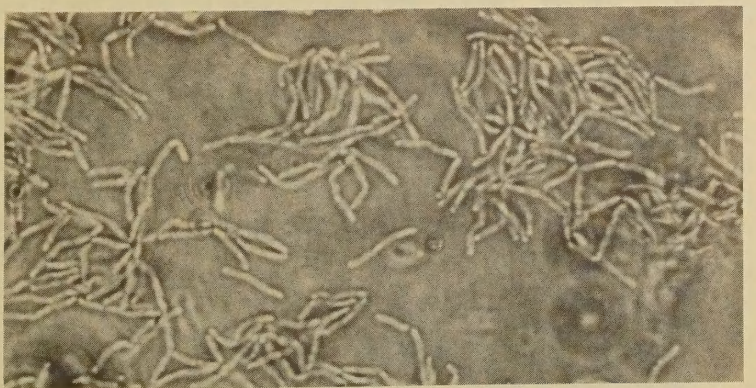
Series of varieties	Resistant No.	Resistant %	Intermediate No.	Intermediate %	Susceptible No.	Susceptible %
1982-86	25	83	2	7	3	10
1987	25	76	4	12	4	12
1988	33	80	8	20	0	0
Total	83	80	14	13	7	7

Ratoon Stunting Disease. The effect of ratoon stunting disease (RSD), caused by Clavibacter xyli subsp. xyli, on six sugarcane varieties was determined. Yield of disease-infected plants was compared to the yield of uninfected plants in plant cane and first-ratoon crops. The effect of the stress of the December 1989 freeze can be noted in the yield loss observed in those crops harvested in 1990. Variety CP 79-318 continued to exhibit resistance to yield loss, although other tests have indicated a high titer of the bacterium in the stalks. RSD caused high yield losses in LCP 82-89 and LHo 83-153. Planting clean seedcane and observing good sanitation practices will be very important in the cultivation of these two new varieties.
(M.P. Grisham)

Percent loss of yield in sugarcane caused by ratoon stunting disease (RSD).

Variety	Year of plant cane crop	Tons cane/acre Plant cane	Tons cane/acre First ratoon	Pounds sugar/acre Plant cane	Pounds sugar/acre First ratoon
CP 65-357	1988	5[a]	11*	6	14
	1989	0	20**	(6)[b]	22**
	1990	12		9	
CP 70-321	1988	0	4	(5)	3
	1989	(3)	16*	(1)	17*
	1990	3		(1)	
CP 72-370	1989	3	30**	0	35**
	1990	11		15	
CP 79-318	1988	(6)	(4)	(10)	(4)
	1989	(8)	0	(8)	(9)
	1990	3		(1)	
LCP 82-89	1988	0	7	(4)	(2)
	1989	21*	53**	26*	59**
	1990	18*		16*	
LHo 83-153	1989	5	34**	0	40**
	1990	43*		45*	

[a] Mean of four replicates. * = significant at P = 0.05, ** = significant at P = 0.01
[b] ( ) = RSD-infected had higher yield than healthy.



Colonies of the ratoon stunting disease bacterium, magnified 4,500X.

ENTOMOLOGY

Yellow Sugarcane Aphid. Mechanisms of resistance to the yellow sugarcane aphid exhibited by six Louisiana sugarcane varieties were studied in the greenhouse. Significant differences were found among varieties for non-preference, antibiosis, and tolerance. Leaf discoloration ratings and reduced photosynthesis, as measured by chlorophyll fluorescence, were negatively correlated suggesting that discoloration induced by aphids is not a good indicator of reduced photosynthesis, and ultimately, reduced yields. These data suggest that the effect of yellow sugarcane aphid on sugarcane is primarily cosmetic. **(W.H. White)**

JUICE AND MILLING QUALITY

Juice Quality. The juice and milling quality laboratory located at the Ardoyne Farm, Houma, Louisiana, processes from 6-10,000 sugarcane samples each year. User groups include federal, state, industry, cooperator and private scientists. To better evaluate juice and cane quality, a commercial pre-breaker and hydraulic press were installed for the 1988/89 harvest, funded by two grants ($50,000) from the American Sugar Cane League through the competitive grants program. Since the prebreaker/press method of analysis takes into account both juice and cane quality of the individual sample, results expressed as the estimated yield of theoretical recoverable sugar per ton of cane (TRS) are similar to predicted values of TRS obtained by 19 of the commercial mills operating in Louisiana. This method is particularly useful to those experiments where cane quality may be affected by the treatments, i.e. cane trash, chemical ripeners, herbicides, diseases, insects, etc. For the 1990 harvest season, 33% of the total samples were processed and analyzed using the prebreaker/press method.

Starch concentration of eight commercial varieties, CP 65-357, CP 70-321, CP 72-356, CP 72-370, CP 74-383, CP 76-331, CP 79-318 and NCo 310 was monitored during the 1989 harvest season in Louisiana. Sampling began in mid-September and continued every two weeks through the first week in December using conventional milling. Other juice characters measured included Brix, sucrose, purity, total polysaccharides and dextran. The results generally showed that CP 72-370 was highest in starch concentration and CP 70-321 was lowest. No associations were found between starch concentration and Brix, sucrose and purity. **(B.L. Legendre, M.A. Clarke, and M.A. Godshall)**

Milling Quality. Milling studies completed in 1989 and 1990 indicated that 14 candidate varieties had fiber content exceeding 14%, LCP 86-429, CP 87-609, CP 87-618, CP 87-625, CP 87-653, CP 87-657, LCP 87-23, LCP 87-492, LCP 87-496, CP 88-725, CP 88-730, CP 88-742, CP 88-772, and CP 88-783. Of these varieties, CP 87-657, LCP 87-492, LCP 87-496, CP 88-725, CP 88-730, and CP 88-783 exceed 14.5% fiber and may present a milling problem if released commercially. **(B.L. Legendre)**

WEED CONTROL AND CULTURAL PRACTICES

Itchgrass Competition and Control. Several years of competition studies showed that a moderate infestation of itchgrass (one plant/sq.m) in plant cane lowered sugar/ha yield by 20% on average. Itchgrass biomass then increased two- to four-fold in the first-ratoon crop and reduced yield 40% on average. Yield loss was caused primarily by reduced stalk populations. The results also showed that sugarcane cultivars vary in their response to itchgrass competition. The cultivar CP 72-356, which developed very high tiller populations in early spring in both the plant-cane and first-ratoon crops, had less yield loss in the first-ratoon crop than CP 74-383 which had a lower tiller population in early spring, particularly in the ratoon crop. The yield loss of CP 65-357 under itchgrass competition was somewhat intermediate between the other two cultivars.

In experiments conducted over several years, the experimental herbicides pendimethalin (PROWL) and prodiamine have given relatively good preemergence control of moderate infestations of itchgrass when applied as soil-surface, nonincorporated treatments. However, these herbicides usually gave significantly less control than the standard soil-incorporated trifluralin treatment, particularly when itchgrass infestations were high. Control was increased to levels comparable to the trifluralin treatment when preemergence treatments with pendimethalin and prodiamine were followed with a postemergence treatment with asulam (ASULOX) to control plants that survived the preemergence treatments. Asulam was most effective when applied to itchgrass less than 25 cm tall. **(R.W. Millhollon)**

Tolerance of Sugarcane Cultivars to Postemergence Herbicides. The commercial sugarcane cultivars CP 65-357, CP 70-321, CP 72-356, CP 72-370, CP 73-351, and CP 74-383 were evaluated in two field experiments for their tolerance to foliar applications of the postemergence herbicides asulam at 3.7 and 6.7 kg/ha, dalapon at 5.0 kg/ha and MSMA (monosodium salt of methylarsonic acid) at 4.5 kg/ha. Herbicides were applied in late April to new spring growth of sugarcane as would be done for control of johnsongrass, but cultivars were maintained weed-free. Cultivar response to the herbicides was determined from early-season shoot height, mature stalk production, and cane yield. Cultivars were not injured by asulam at the standard rate of 3.7 kg/ha. Asulam at 6.7 kg/ha generally caused more initial reduction in plant height and leaf chlorosis, but only CP 72-370 had reduced yield and this in only one experiment. Dalapon reduced early-season plant height for all cultivars, but its effect on number of mature stalks and cane yield at harvest varied with cultivar: CP 72-370 and CP 65-357 were tolerant; CP 73-351 and CP 74-383 had some adverse reaction in one or both experiments; and CP 70-321 and CP 72-356 had consistent reductions in both experiments. MSMA caused temporary leaf desiccation, and generally reduced the early-season growth of all cultivars, but it did not affect mature stalk production for any cultivar. CP 74-383 and CP 72-370 exhibited greater tolerance to MSMA than the other four cultivars which had significant yield reductions in one or both experiments. **(R.W. Millhollon and H.P. Fanguy)**

Bermudagrass Competition Studies. Bermudagrass, transplanted in late-February at 90-cm intervals along rows of CP 65-357 plant cane, was found to develop slowly during the plant-cane and first-stubble crops. In the second-stubble crop, the spread of bermudagrass within the field accelerated because bermudagrass was better established above- and below-ground and sugarcane was less vigorous with fewer stalks being produced. Bermudagrass tended to reduce stalk populations in all years with the greatest reductions coming in the second-stubble crop. Gross cane and sugar yields were reduced to a lessor extent because harvested stalks were generally larger with higher sucrose contents. **(E.P. Richard, Jr.)**

Bermudagrass Control Within the Sugarcane Crop. A replacement for dalapon as a postemergence herbicide treatment for the control of bermudagrass in sugarcane does not exist at this time. Studies conducted for the past four years indicate that some suppression of bermudagrass can be obtained with terbacil (SINBAR), metribuzin (SENCOR/LEXONE), and an experimental herbicide, clomazone (COMMAND), when they are applied in early-March to dormant bermudagrass. Shaving the top of the row to a depth of 2 to 3 cm to remove the above-ground bermudagrass biomass resulted in a significant reduction in bermudagrass levels

Bermudagrass competition in sugarcane.

through layby. Where plots were shaved prior to the application of the preemergence herbicides, bermudagrass control was increased with the effects of the two treatments appearing to be additive. **(E.P. Richard, Jr.)**

Control of Johnsongrass and Bermudagrass in Fallow Fields. Terbacil (SINBAR), metribuzin (SENCOR/LEXONE), and trifluralin (TREFLAN), herbicides registered for use in sugarcane; and pendimethalin (PROWL), prodiamine, clomazone (COMMAND), sulfometuron (OUST), and imazapyr (ARSENAL), experimental herbicides not presently registered for use in sugarcane, were evaluated for preemergence control of johnsongrass and bermudagrass during the period between row formation in early-June and planting in early-September. Oust at 98 g/ha provided excellent control of seedling johnsongrass; it did not control bermudagrass. Arsenal at 560 g/ha provided excellent control of both weeds. None of the herbicides currently registered for the preemergence control of weeds in sugarcane provided acceptable control of either weed alone and required either a spot-application (for johnsongrass) or a broadcast (for bermudagrass) application of glyphosate (ROUNDUP) to produce acceptable (>90%) control of these weeds.

Postemergence herbicides, not presently registered for use in sugarcane, were evaluated for the control of johnsongrass and bermudagrass. Control of both weeds with fluazifop-P (FUSILADE 2000) quizalofop (ASSURE) and glufosinate (IGNITE) was significantly less then that observed with glyposate (ROUNDUP) at rates of 2.24 kg/ha or greater. Fluazifop-P and quizalofop had no activity on broadleaf weeds and nutsedge which were also present in these fields, and controlled (>80%) by glyphosate. In both preemergence and postemergence experiments, reduced levels of weed growth observed during the fallow months was also observed in the fall after planting and in the spring of the plant-cane growing season. No herbicide injury was evident in the newly planted sugarcane. Plant-cane yields were generally higher where the levels of weeds at planting were lower. **(E.P. Richard, Jr.)**

Herbicide Drift Studies. Fluazifop-P (FUSILADE 2000) is often aerially applied to soybean fields at rates of 140 to 210 g/ha to control johnsongrass. Where sugarcane is grown in close proximity to soybeans, accidental applications of fluazifop-P to sugarcane are possible. In field studies, when fluazifop-P was applied to CP 70-321 at 11 g/ha in May and June, cane yields were reduced by 36 to 51%, respectively. Sugarcane appeared to be most sensitive to fluazifop-P when it was applied in May. In greenhouse studies, sugarcane varieties were found to differ in their ability to tolerate fluazifop-P. Variety tolerance, ranked from most tolerant to most susceptible, were CP 70-321 $\geq$ CP 74-383 $\geq$ CP 76-331 $\geq$ CP 65-357 = CP 72-370 $\geq$ CP 79-318. **(E.P. Richard, Jr.)**

GROWTH REGULATORS

Chemical Ripener Glyphosate. In 1989, the ripening effect of the chemical ripener glyphosate, as the isopropylamine salt (POLADO L), was compared to the untreated check (CONTROL) on six commercial varieties, CP 65-357, CP 70-321, CP 72-370, CP 74-383, CP 76-331, and CP 79-318 in the second-stubble crop. Glyphosate was applied at 0.33 kg/ha [0.30 lb (9.5 oz)/ac]. Based on the estimated yield of theoretical recoverable sugar per ton of cane (TRS), all varieties showed an increase at 27 to 56 days after treatment. No response was found for any variety at the 14 day treatment-harvest interval and no decrease in mean stalk weight occurred during the sampling period. No difference in fiber percent cane was detected between treated and non-treated cane, regardless of the variety. **(B.L. Legendre)**

Response of sugarcane varieties to glyphosate (POLADO L)[1]

Variety and treatment	Yield (lb) of sugar/ton (TRS) Treatment-harvest interval (weeks) 2	4	6	8
CP 65-357				
Control	231	253	268	293
POLADO L	231	273	299	298
CP 70-321				
Control	240	258	275	281
POLADO L	244	264	284	281
CP 72-370				
Control	237	255	269	286
POLADO L	249	276	300	302
CP 74-383				
Control	211	221	249	269
POLADO L	232	242	266	291
CP 76-331				
Control	251	266	277	299
POLADO L	258	278	273	313
CP 79-318				
Control	233	245	274	291
POLADO L	245	254	283	301

[1] POLADO L applied at 0.30 lb (9.5 oz)/ac.

Effect of Chemical Ripener Glyphosate in Plant Cane and First-Stubble Cane. Glyphosate (POLADO L) at 0.33 kg/ha [0.30 lb (9.5 oz)ac] was applied at two dates each year (1989 and 1990), to three varieties, CP 65-357, CP 70-321, and CP 74-383, in the plant and first-stubble crops, and harvested at a single harvest date each year to give two treatment-harvest intervals. Glyphosate treatments increased the yield of theoretical recoverable sugar per ton of cane (TRS) over the untreated controls, and the 42-day treatment-harvest interval increased TRS more than did an interval of 28 days. A significant interaction between treatments and varieties was found in the first-stubble crop for spring shoot population, mature stalk population, and yield of cane and sugar/acre. The main cause of the interaction was the differential response of

varieties to glyphosate at the 42-day treatment-harvest interval. CP 65-357 cane treated with glyphosate at the 42-day interval was affected more than the other varieties. The severe freeze that occurred in December 1989 after harvest of the plant-cane crop apparently injured CP 65-357 cane treated with glyphosate at the 42-day interval more than it did the other two varieties. Glyphosate applied at the 28-day interval in plant cane did not affect populations and yield of CP 65-357 in the first-stubble crop. Glyphosate applied only in the first-stubble crop at a treatment-harvest interval of 26 and 42 days increased sugar/acre, as a mean of all varieties, by 4% and 8%, respectively, based on average yield of two untreated controls. Only sugar yield from the 42-day treatment-harvest interval was significantly different from the controls. **(B.L. Legendre and R.W. Millhollon)**

Experimental Chemical Ripeners. Research was conducted to compare the experimental ripener fluazifop-P (FUSILADE 2000) at 0.035 and 0.07 kg/ha with the standard treatment of glyphosate (POLADO L) at 0.33 kg/ha for ripening of the plant-cane and first-ratoon crops of CP 65-357, CP 70-321 and CP 74-383. Fluazifop-P at 0.035 kg/ha increased theoretical recoverable sugar (TRS) by about 4% and 3% in the plant-cane and first-ratoon crops, respectively, as compared to an increase of 9% and 4%, respectively, for glyphosate. Increases in TRS are the mean of 28- and 42-day treatment-harvest intervals. No ripener by cultivar interaction was detected. The higher rate of fluazifop-P generally was not as effective as the lower rate. Both rates of fluazifop-P caused extensive necrosis of leaves and the apical meristem portion of the stalk whereas glyphosate caused almost no necrosis. Such sugarcane injury by fluazifop-P would be expected to reduce photosynthesis and thus reduce both sugar accumulation and growth of stalks. **(R.W. Millhollon and B.L. Legendre)**

1989 Climatic Conditions

Sugarcane Field Laboratory, Houma, Louisiana

	Temperature, °F		Rainfall, in.		No. rainy days	
Month	Mean	Depart.	Total	Depart.	Total	Depart.
Jan.	60.8	+ 5.9	3.47	- 0.81	8	0
Feb.	56.2	- 0.7	0.02	- 4.27	4	- 4
Mar.	63.0	+ 0.5	4.59	+ 0.16	8	0
Apr.	67.0	- 1.6	2.78	- 1.44	7	+ 1
May	76.3	+ 1.6	6.97	+ 2.47	6	- 1
June	79.4	- 0.5	9.51	+ 3.44	16	+ 6
July	80.9	- 0.3	10.12	+ 2.03	17	+ 2
Aug.	80.7	- 1.7	3.99	- 3.26	11	- 3
Sept.	76.1	- 2.3	3.90	- 2.80	14	+ 4
Oct.	67.0	- 2.8	0.47	- 3.28	5	0
Nov.	62.7	+ 1.6	3.60	- 0.23	14	+ 8
Dec.	45.6	- 9.4	3.46	- 1.46	14	+ 6
Total		- 9.7	52.88	- 9.45	124	+19

1990 Climatic Conditions

Sugarcane Field Laboratory, Houma, Louisiana

	Temperature, °F		Rainfall, in.		No. rainy days	
Month	Mean	Depart.	Total	Depart.	Total	Depart.
Jan.	57.9	+ 3.0	6.05	+ 1.77	11	+ 3
Feb.	60.3	+ 3.4	8.84	+ 4.55	13	+ 5
Mar.	62.5	0	7.33	+ 2.90	8	0
Apr.	67.3	- 1.3	2.49	- 1.73	8	+ 2
May	76.3	+ 1.6	2.61	- 1.89	5	- 2
June	81.4	+ 1.5	3.17	- 2.90	7	- 3
July	81.1	- 0.1	5.63	- 2.46	12	- 3
Aug.	81.1	- 1.3	3.80	- 3.45	14	0
Sept.	78.1	- 0.3	6.97	+ 0.27	10	0
Oct.	66.4	- 3.4	1.46	- 2.29	4	- 1
Nov.	61.7	+ 0.6	2.78	- 1.05	5	- 1
Dec.	57.5	+ 2.5	4.05	- 0.87	13	+ 5
Total		+ 6.2	55.18	- 7.15	110	+ 5

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